Electronic Supplementary Information (ESI)

Smart Functional Surfactant Activated Conductive Polymer Coated on Paper with Ultra-Sensitive Humidity Sensing Characteristics

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S1. Response and revcovery time of the sensor

The response and recovery time taken by the sensor to reach a saturation value (96-98%) is shown in **Fig. S1.** The response time of the sensor showed a linear change with the increase in humidity. The recovery time was increased at higher humidity conditions, indicating the slow desorption of water molecules from the sensor surface. For example, the time taken by the PANI/SLS-0.25 based sensor to reach 90 % of the total resistance change during the adsorption process at 80 RH% was 18 s, while it took another 6-7 s to reach its final saturation value (> 96-98%). Similarly, for the desorption process, the sensor took 27 s to reach 90 % of the total resistance change, while 42 s to reach its final value.

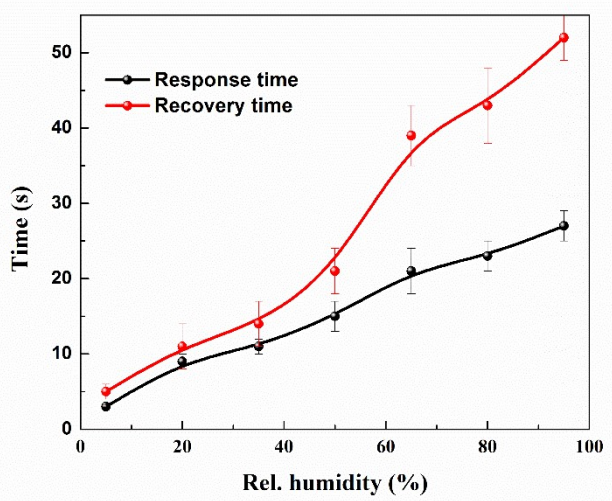

Fig. S1 Response and recovery time of PANI/SLS-0.25 sensor at different humidity conditions.

S2. Long term stability of the sensor

Fig. S2a and S2b illustrate the long-term stability of PANI/SLS-0.25 sensor when repeated exposed to 100 cycles and 50 days, respectively. The response of the sensor was taken as the average of the three values. The response of the sensor was taken as the average of the three values. The sensor was repeatedly exposed to humidity conditions varying between 30 and 60 %. The response (red) and recovery time (blue) of the sensor upon repeated exposure are given in the **Fig. S2a and S2b.** The response of the sensor was slightly decreased after being repeatedly exposed for 100 cycles. For initial cycle, the response was ~62 %, while it was 59 % after 100 cycles. On the other hand, there was no significant change was observed in the sensor response when repeatedly exposed to the humidity conditions for 50 days. Such a long-term stability of the sensor suggests excellent absorption and desorption characteristics of the sensor.

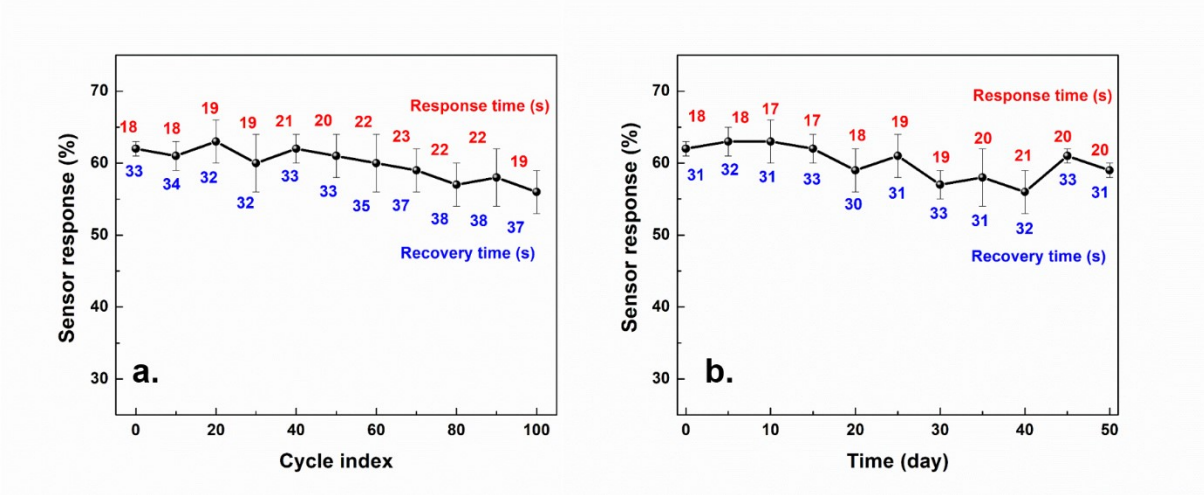

Fig. S2 Response of PANI/SLS-0.25 based humidity sensor **a.** Reproducibility of the sensor after repeated exposure to humidity (30 – 60 %RH); **b.** Stability of the sensor when exposed to humidity (30 – 60 %RH) for 50 days.

S3. Sensor performance

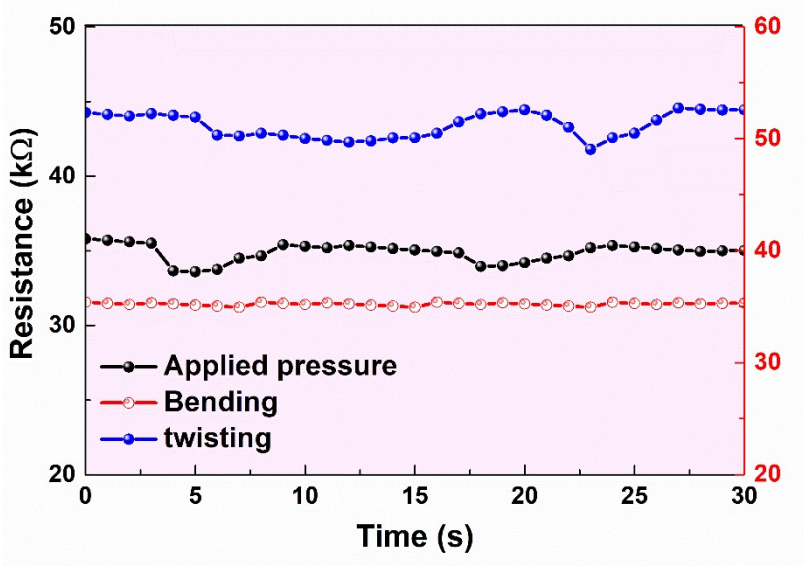

Fig. S3 Resistance change of PANI/SLS-0.25 coated paper sensor upon the application of pressure, bending mode and twisting mode.